MESA

MINE ELECTRICAL
SAFETY ASSOCIATION INC.

MINING ELECTRICAL SAFETY 2017 CONFERENCE

10 – 12 JULY 2017

PULLMAN KING GEORGE SQUARE HOTEL,
BRISBANE

mesaqld.com.au

Batteries Ain’t Batteries

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Acknowledgements

1. Australian Battery Industry Association Ltd
2. Battery explosion injures employee – Mineral Resources (NSW), Alert No. 00-26, November 2000
3. Battery explosions with certain Caterpillar Maintenance Free Batteries – Hastings Deering CAT, Bulletin No. 23, April 2007
4. Battery failures on fire pump sets – Australian Industrial Pump Systems, June 2011
5. Preventing battery explosions - Worksafe (Victoria), Nov 2012
5. Battery and charging system hazards – Hastings Deering CAT, Bulletin 4/2015, October 2015.
6. Exploding lead acid batteries – Department of Natural Resources and Mines (Queensland), Bulletin No. 150, October 2015.
7. Risk associated with electric storage batteries – NOPSEMA, Alert No. 61, November 2015.
8. Exploding lead acid batteries – Department of Industry Resources and Energy (NSW), Bulletin No. SB16-02, May 2016.
9. www.batteryuniversity.com
10. www.batterycouncil.org

The following presentation does not relate content to any particular battery brand or specific minesite.

Introduction

One size/technology fits all?

We typically take batteries for granted – replace them when we need to and the job goes on.

When something does goes wrong – the question becomes, why?

Introduction
Why is it happening?

The trend of battery explosions have increased over the years for mobile and stationary plant.

November 2015 to May 2016: 4 reported battery explosions (SB16-02).

Understanding Batteries

In general terms, most batteries are:

1. Designed to:
    a) Supply extra power, as required, instead of relying on the alternator;
    b) Buffer voltage spikes; and are
    c) Voltage regulated via the alternator.
2. Categorised by: physical format; amp hours; cold cranking amps; & reserve capacity.

There are 2 main applications of batteries:

1. Automotive (Starter / SLI) – refer to AS2149
2. Stationary – refer to AS4029 and AS3731

Using SLI batteries in a Stationary application will result in failure & increased risk of explosion!

Be warned – battery type terminology is interchangeable amongst manufacturers!

Battery Killers

1. Heat – temperatures above 25C accelerate the chemical process in the battery;
2. Corrosion – poor terminals and connections result in high resistances/hot spots;
3. Sulfation – batteries not fully charged and remain discharged result in electrodes having a hard coat of lead sulfate weakening the battery;
4. Incorrect application – wrong battery type, vibration, quality etc

Mine sites aren't an ideal location for battery longevity!

Technology Advancement

The Incident

The Incident

Fleet	QTY	OEM Battery Part Number	CCA	RC	Ah	OEM Battery Specification (Minimum)
Excavators						
Hitachi EX1900	4	4354442	1200	465	200	Maintenance Free
Hitachi EX2600	4	4354442	1200	465	200	Maintenance Free
Hitachi EX3600	4	4354442	1200	465	200	Maintenance Free
Hitachi ZX470	2	4192421				
Hitachi ZX240	2	4628452			88	
Liehber R9800	6	6002876	1000	345	170	
CAT 6060	6	153-5720	1500	465	210	Maintenance Free Calcium Grids Accessible Vent Caps
CAT 6030	6	153-5720	1500	465	210	Maintenance Free Calcium Grids Accessible Vent Caps
Loaders						
CAT 988H	4	115-2422	1000	170	90	Maintenance Free Calcium Grids Accessible Vent Caps
CAT 993K	4	153-5710	1400	425	200	Maintenance Free Calcium Grids Accessible Vent Caps
Dump Trucks - Mechanical						
CAT 785B	2	3T-5760	750	165	100	Maintenance Free
CAT 785C	4	175-4390	1000	180	90	Maintenance Free Calcium Grids Accessible Vent Caps
CAT 789B	2	3T-5760	750	165	100	Maintenance Free

That seems straight forward but is there anything else we can do?

What We Need to Know

Safety Alerts/Bulletins

1. Battery explosion injures employee – Mineral Resources (NSW), Alert No. 00-26, November 2000.
    - Recommends safe work procedures and training for safe operation, maintenance and charging of batteries.
2. Battery explosions with certain Caterpillar Maintenance Free Batteries – Hastings Deering CAT, Bulletin No. 23, April 2007.
    - Highlights causes include: high battery operating temperature; overcharging; significant electrolyte loss.
3. Battery failures on fire pump sets – Australian Industrial Pump Systems, June 2011
    - Review maintenance of batteries of fire pumps and replace batteries every 2 years.
4. Preventing battery explosions - Worksafe (Victoria), Nov 2012
    - Highlights the difference between SLI and stationary batteries.

What We Need to Know

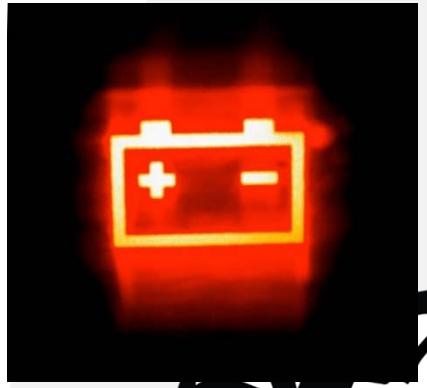
Lets put it all together…..

Are Maintenance Free Batteries the Right Batteries for Mining?

1. Heat – batteries operating above 25C will have a reduced life (i.e. lost electrolyte)
   - Battery operable temperature range;
   - Temperature compensation on charging circuits – especially whilst operating;
   - Is ventilation adequate (e.g. forced)?

2. Voltage – overcharging may occur
   - Is the alternator (voltage regulator) or charging system correct for the battery type;
   - Review alternator/charger replacements or repairs.

3. Operation of equipment
   - Does equipment start regularly or operate 24x7;
   - Vibration rating;
   - Batteries secure;
   - Correct battery for the equipment application.



Are Maintenance Free Batteries the Right Batteries for Mining?

4. Maintenance and Replacement
    - Procurement – OEM specifications met for batteries, alternators and chargers;
    - Maintenance regime (e.g. replacement of batteries);
    - Testing requirements (e.g. accessing/testing batteries after turning equipment off);
    - Load test or battery analyser – complete testing offsite?
5. Safety handling and emergency procedures

Contact your Battery Manufacturer and OEM for assistance.

Other Concerns we Need to be Aware of….

1. Does the tradesman go straight for the battery analyser or a voltmeter?
   a) The skill of using a voltmeter and looking at the battery has been lost (i.e. 2.1V per cell – rule of thumb, or seeing the case is swollen/leaking)

2. Are battery analysers results accurate?
   a) There is no industry standard for analysers (only IEEE450, IEEE1180 & IEEE1106)
   b) Analysers work from various methodologies and the results vary
      - Current discharge (assumes full capacity when tested, but not age of batte
      - Impedance (assumes used when tested, calculates based on impedance inc ease with ages)

Other Concerns we Need to be Aware of….

3. Some battery manufacturers highlight why various makes and models of battery analysers produce differing results.
   a) Analysers typically determine the state of the battery by the internal resistance but they cannot determine how much material is left. Hence the indicated CCA is not accurate as compared to a proper load test.
   b) Different battery manufacturing design techniques can effect the reading on one analyser as common algorithms are used. A more durable battery (i.e. more material & higher density) will show lower voltage but longer discharge times.
   c) CCA can be measured to SAE, EN, DIN or IEC standards. Analysers are calibrated towards the EN50342, EN2 requirements. However the numbering system (ETN) used is difficult for a typical person to understand (e.g. 580-063-039) when testing.
   d) Condition of battery leads/terminals can influence the results.
   e) A 2yr old battery may indicate 75% health due to wear/tear but still have significant life left.
   f) A deeply discharged battery can give a good CCA reading but if load tested will show to be in poor condition.

Other Concerns we Need to be Aware of….

4. Gone are the days of lead acid battery jump start packs….. Introducing Lithium in 2011.
   a) Two important factors in choosing the correct jump pack is temperature and CCA. The lower the temperature , the more CCA is required.
   b) If overloaded, overcharged, undercharged or punctured they can become unsafe.
   c) A lifespan of roughly 2 to 3 years.

A lot of power from a small device, but no free lunches here, so the designer has to include protection circuits, fire proofing and quality parts – if they choose…..

Conclusion

1. Procurement – are you getting a quality battery?
2. Correct battery for the application – stationary or starter
3. Equipment operation and design appropriate – charging, heat and ventilation
4. Correct charging equipment – including alternators and regulators
5. Maintenance regimes including:
    - Electrolyte levels (where possible)
    - Checking the hydrometer, valves are clear and caps secure
    - Check for hot spots, cracks, leaks or swelling
    - Cables, connections, insulation and tie-downs
    - Replace maintenance free batteries every 2 to 3 years
6. Process for battery disposal and offsite load testing
7. Battery analysers – good for “general” condition only
8. Correct PPE and test equipment
9. Training for personnel including battery testing and safe handling (e.g. wait times before accessing batteries after the plant has been turned off)
10. Incorporate into your site risk assessment and management systems

Thank you!


BACK IN MY DAY
EVERYTHING HAD BATTERIES THAT NEEDED TO BE CHANGED
VIA 9GAG.COM